

WHAT IS CLAIMED IS:

1. A method for making a perpendicular magnetic recording head comprising the steps of:

(a) forming an auxiliary magnetic pole layer with a magnetic material;

(b) forming a coupling layer on the auxiliary magnetic pole layer with a magnetic material behind an opposing face, opposing a recording medium, of the perpendicular magnetic recording head;

(c) forming a coil layer in a region behind the opposing face;

(d) depositing an insulating layer on the auxiliary magnetic pole layer and depositing a plating base layer on the insulating layer;

(e) forming a resist layer on the plating base layer, and forming a groove in the resist layer, the width, at a position corresponding to the opposing face, of the groove in the track width direction gradually increasing from the bottom to the top of the resist layer, the groove having a predetermined length from the opposing face toward the backside;

(f) forming a main magnetic pole layer in the groove by plating;

(g) planarizing the top face of the main magnetic pole layer by milling in which milling particles enter at a tilt angle from the normal to the main magnetic pole layer;

(h) removing the resist layer: and

(i) coupling the main magnetic pole layer with the coupling layer directly or by forming a yoke layer on the coupling layer over the main magnetic pole layer and the coupling layer.

2. A method for making a perpendicular magnetic recording head according to claim 1, wherein said step (e) further comprises annealing the resist layer after forming the groove to deform the groove so that the width of the resist layer in the track width direction gradually increases from the bottom to the top of the resist layer.

3. A method for making a perpendicular magnetic recording head according to claim 1, wherein, in said step (e), the patterning precision of the resist layer is adjusted so that the width of the resist layer in the track width direction gradually increases from the bottom to the top of the resist layer.

4. A method for making a perpendicular magnetic recording head according to claim 1, wherein the tilt angle in said step (g) is in the range of 45° to 80°.

5. A method for making a perpendicular magnetic recording head according to claim 1, wherein the tilt angle in said step (g) is in the range of 60° to 70°.

6. A method for making a perpendicular magnetic recording head according to claim 1, further comprising the step (j), subsequent to said step (h), of removing the plating base layer in regions other than the main magnetic pole layer by ion milling in a direction which tilts by a predetermined angle from the normal to the main magnetic pole layer.

7. A method for making a perpendicular magnetic recording head according to claim 1, wherein the plating base layer is formed of a magnetic material in said step (d).

8. A method for making a perpendicular magnetic recording head according to claim 1, wherein the plating base layer is formed of a nonmagnetic material in said step (d).

9. A method for making a perpendicular magnetic recording head according to claim 1, wherein, in said step (j), the width of the plating base layer in the track width direction is larger than the width of the bottom face of the main magnetic pole layer in the track width direction when the protective layer is removed.